Gracilis transplantation and temporalis transposition in longstanding facial palsy in adults

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Gracilis transplantation and temporalis transposition in longstanding facial palsy in adults: patient-reported and aesthetic outcomes.

Summary

Background: In longstanding facial palsy, gracilis free functional muscle transfer (FFMT) is currently considered gold standard in smile reanimation. An alternative to muscle free flaps is local muscle transposition, with the temporalis muscle transposition being the ~~favourable~~ preferred procedure, because of its direction of pull when transposed. The present study aimed to compare outcomes of gracilis FFMT neurotised by the masseteric nerve and temporalis muscle transposition in longstanding facial palsy using patient-reported and aesthetic outcomes.

Methods: A cross-sectional comparison of gracilis FFMT and temporalis muscle transpositions was performed. Pre- and postoperative excursion measures were obtained. Patients were asked to answer a satisfaction questionnaire, quality of life questionnaire (FaCE scale) and a depression and anxiety questionnaire (HADS). Laypeople were asked to rate the pre- and postoperative aesthetic appearance.

Results: Of 28 eligible patients, 10 gracilis and 12 temporalis patients participated. No significant differences were found between both groups in postoperative quality of life or depression/anxiety. Layperson observers judged the aesthetic appearance to be similar.

Conclusion: In the present study, gracilis FFMT did not lead to superior quality of life and aesthetic outcomes compared to temporalis muscle transpositions. The facial nerve specialist should perform the procedure he or she expects to lead to optimal results for the patient.

Key words: Facial palsy; facial paralysis; gracilis muscle; temporalis muscle; quality of life; FaCE scale

Introduction

The ultimate goal of facial reanimation surgery is to restore movement of the paralyzed face. In longstanding facial palsy muscle tissue has to be replaced, since the native facial muscles are atrophied and fibrosed making reinnervation impossible.(Garcia, Hadlock et al. 2015) The gracilis free functional muscle transfer (FFMT) is currently considered the gold standard(Garcia et al. 2015), ideally neurotised by an ipsilateral or contralateral branch of the facial nerve. When this is expected to lead to unfavourable results, the masseteric nerve is a popular choice, because of its low donor site morbidity, strong motor input and relatively fast functional recovery.(Boahene 2008, Klebuc 2011) An alternative to muscle free flaps are local or regional muscle transpositions.(Garcia et al. 2015) Temporalis muscle transposition is the ~~favourable~~ preferred procedure because of the correct vector of pull.(Baker, Conley 1979) Such procedures do not require microsurgical skills and may be seen as a viable alternative for free flap procedures, specifically in elderly or medically less fit patients, because of a shorter operation time, immediate results and usually a better static correction.(Garcia et al. 2015, Hembd, Harrison et al. 2018)

Several studies compared different techniques of muscle transplantation and temporalis muscle transposition in facial palsy using different assessment methods and scales.(Cuccia, Shelley et al. 2005, Erni, Lieger et al. 1999, Gousheh, Arasteh 2011, Hembd et al. 2018) Postoperative excursion (i.e. absolute distance between the corner of the mouth with smile compared to at rest) is reported to be larger after FFMT.(Bos, Reddy et al. 2016, Hembd et al. 2018) However, none of these studies focused on patient-reported outcomes and aesthetics. The present study aimed to compare outcomes of gracilis FFMT, neurotised by the masseteric nerve, with temporalis muscle transpositions using patient-reported and aesthetic outcomes.

Methods

This study is a cross-sectional multicentre evaluation with prospectively collected data of two tertiary university hospitals in the Netherlands. The institutional review boards of both centres did not deem formal approval necessary prior to this study (Erasmus MC 2016-699 / UMCG 2016.383).

Patients

Two groups of patients were included, one group treated with a gracilis FFMT neurotised by the masseteric nerve at one institution (Erasmus MC Rotterdam treated by MAMM) and a second group treated with a temporalis muscle transposition at the other institution (UMCG Groningen treated by PMNW).

Patients were identified using treatment codes for temporalis muscle transposition and gracilis FFMT, operation lists, and personal records. All identified adult patients were invited to participate in this study. Exclusion criteria were unwillingness to come to our institution or be visited by one of the investigators at home, and the lack of a set of preoperative photographs.

Operative techniques

All segmental gracilis FFMT were one-stage procedures in which the gracilis muscle was neurotised by a branch of the masseter nerve according to the technique described by Manktelow et al.(Manktelow, Tomat et al. 2006); it was revascularized by the superficial temporal vessels. The temporalis muscle transpositions were done according to a previously described antidromic Rubin technique.(van Veen, Korteweg et al. 2018)

Data collection

Patient characteristics and pre- and postoperative data were collected from the medical charts and operative note(s). Preoperative photographs were collected from the medical charts, and patients were asked to come to our institution to take a new set of photographs at final follow up. The pre- and postoperative photographs were analysed using the FACE-gram software.(Hadlock, Urban 2012) All FACE-gram analyses were performed by the primary investigator (MMvV).

Additionally, patients were asked to complete a questionnaire consisting of some questions regarding their current state of treatment and their satisfaction with the operation result and specifically the aesthetic and functional outcome of the operation, rated on a 100 millimetre (mm) visual analog scale (VAS). Patients were asked to answer a questionnaire for disease-specific quality of life for facial palsy, and an inventory questionnaire for depression and anxiety. The Facial Clinimetric Evaluation (FaCE) scale is a validated and much used questionnaire for disease-specific quality of life in facial palsy.(Kleiss, Beurskens et al. 2015) The questionnaire produces a total score and six sub scores. All scores range from 0 (worst) to 100 (best). The Hospital Anxiety and Depression Scale (HADS) is an inventory questionnaire for depression and anxiety.(Zigmond, Snaith 1983, Spinhoven, Ormel et al. 1997) HADS scores (ranging 0 to 27) were grouped according to the following cut-off points. Scores ≤ 7 were classified as “no depression or anxiety”, 8-10 points as “minor depression/anxiety”, 11-15 points as “moderate depression or anxiety”, and ≥ 16 points as “severe depression or anxiety”.(Zigmond, Snaith 1983)

Finally, photographs of 21 patients were rated regarding aesthetic appearance; one temporalis muscle transposition patient did not want his photographs to be used for this purpose. The pre- and postoperative photographs were rated by 30 independent laypersons. They were non-

cosmetic visitors of the outpatient plastic surgery clinic. They were shown a PowerPoint slide with three photographs of the patient: one at rest, one with a closed mouth smile, and one with a teeth-exposing smile. The laypersons were asked to rate the aesthetic appearance of each slide on a 100 mm VAS, with zero standing for "absolutely not beautiful" and 100 standing for "absolutely very beautiful". A 'mean aesthetic score' was calculated from the 30 independent observations of each PowerPoint slide.

The two acting surgeons (MAMM and PMNW) were not involved in the analyses and none of the outcome assessors were involved in the treatment of the patients.

Statistical analysis

All statistical analyses were performed using SPSS version 24.0 (IBM, NY, USA). Nominal data are presented as frequencies and percentages, ordinal data are presented using medians and interquartile ranges (IQR). Due to non-normality, continuous data are presented as medians and IQR. Chi-squared and Fisher exact tests were used to test for a difference between treatment groups in nominal data, Mann Whitney U tests were performed in ordinal and continuous data. Inter-rater agreement for rating of the aesthetic appearance was analysed using an intra-class correlation coefficient (ICC) (two-way random, absolute agreement).

Results

Initially, 11 patients with a gracilis FFMT and 16 with a temporalis muscle transposition were identified and reached. Four patients did not want to participate in our study; one patient did not show up at our institution and was not contactable afterwards. Reason for not participating was stress in the patients' personal life or at work. Therefore 10 patients with gracilis muscle transplantation and 12 with temporalis muscle transposition were included for analysis. Most patients were male (64%) and presented with facial palsy after resection of a vestibular

schwannoma (36%) (Table 1). Age at the time of reanimation, duration of the palsy and follow-up time since the facial reanimation procedure did not differ significantly between both groups (Table 1). One gracilis muscle transplantation patient developed a postoperative wound infection. Two temporalis muscle transplantation patients developed a postoperative complication: an abscess and some minor skin necrosis. All patients received additional treatment either before, concurrent with or after the studied procedure (Table 2).

Smile and symmetry analysis

Smile excursion and symmetry analyses showed no statistically significant differences between both groups, although absolute values differed somewhat (Table 3). Postoperative excursion of the affected side was slightly larger for the temporalis muscle transposition patients. Symmetry, in repose but not with smile, was slightly better after gracilis muscle transplantation. Change scores (postoperative minus preoperative score) were similar for both groups (Table 3).

Patient-reported outcome measures

Largest median differences found in FaCE scale sub scores were 18.7 points for the eye ~~control~~ comfort score in favour of the temporalis transposition patients and 15.6 for the social function score in favour of the gracilis FFMT patients. Median oral function scores were slightly higher in the temporalis transposition patients (6.3 points difference). Median facial movement scores were the same in both groups (25.0 points). Total FaCE scale scores differed only 1.7 points in favour of the gracilis FFMT patients. None of the FaCE scale score differences was statistically significant (Table 4). None of the gracilis FFMT patients were classified as having depression or anxiety. Two temporalis muscle transposition patients were classified as having a minor depression and minor anxiety (p=0.481).

Median (IQR) VAS score for patient satisfaction with the operation result, aesthetic outcome and functional outcome were all in favour of the gracilis FFMT patients, although none of the differences were statistically significant (Figure 1). The most frequently reported complaint in aesthetics was the appearance of the eye (55% of all patients, equally divided over both treatment groups). Only three gracilis FFMT patients reported the appearance of the cheek area as bothersome and two temporalis muscle transposition patients reported the appearance of the temporal area as bothersome. Regarding functional outcome, problems with the eye were again most frequently reported (64% of all patients, equally divided over both groups).

Aesthetic result

ICC for inter-rater agreement for aesthetic appearance rating was 0.262, highlighting the highly individual nature of aesthetic preferences. Pre- and postoperative 'mean aesthetic scores' (of the laypersons) did not differ significantly between both treatment groups (p=0.426 and p=0.863 respectively)(Figure 2). A selection of preoperative and postoperative patient photographs is shown (Figure 3).

Discussion

In the present study, we compared gracilis FFMT neurotised by the masseteric nerve to temporalis muscle transpositions, most notably on patient-reported and aesthetic outcomes. No statistically significant differences were found between both groups, although most absolute differences were slightly in favour of the gracilis FFMT.

Small postoperative differences were seen in mm of excursion and symmetry of the mouth, the largest being a difference of 2.5 mm excursion of the corner of the mouth in favour of

temporalis muscle transposition compared to gracilis muscle transplantation. All change scores were similar between both groups (Table 3). The excursions measured for gracilis muscle transplantation patients in the present study, were relatively small compared to the literature (postoperative median excursion of 1.1 mm versus a mean of > 6 mm excursion).(Bos et al. 2016, Cuccia et al. 2005, Erni et al. 1999) ~~The relatively small excursion could however underestimate the true effect of the gracilis muscle transplantation, also on patient-reported outcomes.~~ Hypothetically, the relatively small excursion that we have measured could mean that we are also measuring lower patient-reported outcomes compared to other centres.

The median Total FaCE scores after gracilis FFMT and after temporalis muscle transposition did not differ significantly (Table 4). These scores are similar to postoperative Total FaCE scale scores in the literature, ranging from a mean of 57.9 to 58.5 after gracilis FFMT in adults.(Luijmes, Pouwels et al. 2017) We are unaware of reported Total FaCE scores after temporalis muscle transposition. A relatively large difference in median quality of life between both treatment groups was seen in the social function sub score (87.5 vs. 71.9, gracilis FFMT vs. temporalis muscle transposition)(Table 4). In our sample of patients this difference was largely due to one unsatisfied outlying temporalis muscle transposition patient with a minor depression and low self-reported aesthetic VAS score, possibly indicating lower self-esteem and more psychosocial stress as a result.(Pruzinsky 1992, Macgregor 1990, Dey, Ishii et al. 2017) The facial movement and oral function sub scores, relevant for reanimation of the mouth region, were very comparable between both groups (Table 4).

The most heard complaint from patients, both in aesthetics and function, were problems with the eye. Similarly, median eye comfort scores and lacrimation control scores of the FaCE

scale were relatively low (gracilis muscle transplantation vs. temporalis muscle transposition: 31.3 vs. 50.0 and 50.0 vs. 37.5 respectively)(Table 4). Interestingly, the surgical procedures studied do not address periocular problems coming with facial palsy. This could mean that periocular problems have been somewhat overlooked, or that periocular problems have a relatively high weight on quality of life in facial palsy. Only one gracilis muscle transplantation patient and one temporalis muscle transposition patient complained of the aesthetics of the cheek and temporal area respectively. This indicates that the aesthetic morbidity of both procedures is more or less equal, although median self-reported satisfaction with the aesthetic result of the operation was higher in the gracilis FFMT group.

One of the most stated negative sides of temporalis muscle transposition is the aesthetic penalty of the resulting donor site defect, with temporal hollowing and, depending on the exact procedure, zygomatic bulging. We could not confirm these side effects in our layperson aesthetical assessment. No statistically significant differences were found in preoperative and postoperative scores.

The main limitation of our study is its small sample size. In a post hoc analysis we analysed the mean Total FaCE scores and social function sub score in order to determine the amount of patients needed for the current results to become significantly different. For each group, 281 patients would be needed based on the Total FaCE score and 30 patients based on the social function score. This study can somewhat be seen as hypothesis generating. Although most differences in postoperative patient-reported outcomes direct in favour of the gracilis FFMT, studies with larger sample sizes or meta-analysis of smaller studies including patient-reported outcomes after gracilis FFMT and temporalis transposition will have to be done to establish if one of the procedures is superior with regard of patient-reported outcomes. Preferably we

would have analysed preoperative FaCE scale scores as well. In that way differences in preoperative state could have been corrected and individual changes scores for all variables could have been studied. However, a validated facial palsy-specific quality of life questionnaire was not available in Dutch at the time of operation for a large majority of patients.

Another limitation is the inclusion of two patient groups of different centres, which might introduce a centre effect. This form of confounding has likely been limited since patient characteristics were comparable between groups and similar postoperative protocols including physical therapy by therapists that followed the same training.

Comparing the present study to others is further hampered by the wide range of subjective and objective scoring methods used and different patient-reported outcome measures being reported. Development and standardization of a minimal set of outcome measures would be of great value.(Dong, Zuo et al. 2018)

Although only postoperatively, this study is the first to compare patient-reported outcome measures and aesthetics between free muscle transplantations and regional muscle transpositions in facial palsy. In our opinion, quality of life should always be the main outcome. Median oral function scores differed less than 7 points and median facial movement scores were the same. The difference in median social function sub scores could possibly be related to lower self-rated appearance in the temporalis muscle transposition patients, which is an interesting point for further research. However, the true differences in effects of the treatments can ultimately only be studied in a randomized clinical trial. The aesthetical comparison performed is unique and very interesting given the fact that the most stated

disadvantage of the temporalis muscle transposition would be the aesthetics of the donor site defect. Our data did not confirm this disadvantage.

Conclusion

We conclude that both gracilis FFMT and temporalis muscle transposition are viable treatment options in the treatment of adults with longstanding and irreversible flaccid facial palsy. More comparison studies should be published involving patient-reported outcomes. Factors such as previous attempts at reanimation, the availability of donor vessels and/or nerves, and overall prognosis may dictate the optimal surgical approach. Until more evidence is published the choice remains a practice based decision. The facial nerve specialist should perform the procedure he or she expects to lead to the optimal result for the patient.

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Conflict of interest

None of the authors have anything to disclose related to the current manuscript. None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.

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Figure 1. Boxplots showing the distribution of the overall satisfaction with the operation result, satisfaction with the aesthetic result and satisfaction with the functional result. In dark blue the gracilis muscle transplantation patients (n=10), in light blue are the temporalis muscle transposition patients (n=12). None of the satisfaction scores were statistically significantly different between treatment groups (*p*=0.758, *p*=0.221 and *p*=0.221 respectively).

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Figure 2. Boxplots showing the distribution of the 'mean aesthetic score'. In dark blue the gracilis muscle transplantation patients (n=10), in light blue are the temporalis muscle transposition patients (n=11). Both preoperative and postoperative scores were not statistically significantly different between treatment groups (*p*=0.426 and *p*=0.863 respectively).

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Figure 3. A selection of patient photographs with corresponding Total Facial Clinimetric Evaluation (FaCE) scale[15] scores. (*Left*) Preoperative smile photograph, (*Middle*) postoperative smile photograph, (*Right*) Total FaCE scale score. (*Top two*) Gracilis muscle transplantation, (*Bottom two*) temporalis muscle transposition.

Table 1. Patient characteristics

	Gracilis transplantation (n=10)	Temporalis transposition (n=12)	Test-statistic	*p*-value
Male gender (n (%))	4 (40)	10 (83)	-	0.074[c]
Age at time of reanimation, years (median (IQR))	59.1 (56.0; 61.5)	53.9 (49.2; 66.2)	45.0[a]	0.346[d]
Cause of palsy (n (%))			-	0.265[c]
Vestibular schwannoma	5 (50)	3 (25)		
Bell's palsy	2 (20)	3 (25)		
Congenital	-	3 (25)		
Other	3 (30)	3 (25)		
Left sided (n (%))	7 (70)	4 (33)	2.9[b]	0.265[e]
Complete preoperative facial palsy (n (%))	8 (80)	9 (75)	-	1.000[c]
Duration of palsy, years (median (IQR))	8.2 (2.2; 13.8)	13.2 (4.2; 45.7)	46.0[a]	0.381[d]
Follow-up, years (median (IQR))	5.1 (1.7; 6.3)	6.2 (2.1; 15.9)	46.0[a]	0.381[d]

[a] Mann-Whitney U, [b] Chi-Square value, [c] Fisher's exact test, [d] Mann Whitney U test, [e] Pearson Chi-Square test.

Abbreviations: IQR: interquartile range, n: number.

Table 2. Additional procedures

	Gracilis transplantation (n=10)	Temporalis transposition (n=12)
Preoperative (n)		
Periocular static correction	14	10
Facelift	-	3
Muscle reconstruction facial palsy	1	3
Nerve reconstruction facial palsy	1	1
Lipofilling	1	1
Skin excision(s)	-	1
Static correction lower lip	-	1
Peri- and postoperative (n)		
Periocular static correction	20	18
Wedge excision upper and/or lower lip	-	5
Facelift	2	1
Secondary tightening/repositioning	1	2
Skin excision(s)	-	3
DLI excision	2	-
Lipofilling	-	1

Abbreviations: DLI: depressor labii inferioris, n: number.

Table 3. Excursion and symmetry measurements

	Gracilis transplantation (n=10)	Temporalis transposition (n=12)	Test-statistic[b]	*p*-value[c]
Excursion affected side, mm (median (IQR))				
Preoperative	-2.0 (-4.7; -0.4)	-2.0 (-4.6; 1.6)	53.0	0.674
Postoperative	1.1 (0.4; 3.1)	3.6 (-0.7; 6.4)	49.0	0.497
Δ[a] Excursion	4.1 (3.2; 5.5)	3.5 (0.3; 7.5)	46.0	0.381
Symmetry in repose, mm (median (IQR))				
Preoperative	5.9 (4.1; 9.3)	8.6 (3.5; 10.7)	50.0	0.539
Postoperative	2.7 (0.8; 3.5)	3.4 (-0.7; 6.3)	55.0	0.771
Δ[a] Symmetry in repose	-4.1 (-6.9; -1.8)	-4.5 (-8.8; -2.3)	49.0	0.497
Symmetry with smile, mm (median (IQR))				
Preoperative	16.2 (9.7; 19.9)	13.8 (8.5; 17.3)	47.0	0.418
Postoperative	5.3 (2.0; 7.8)	3.9 (1.5; 8.0)	49.0	0.497
Δ[a] Symmetry with smile	-10.4 (-15.6; -5.9)	-10.7 (-14.7; -5.4)	57.0	0.872

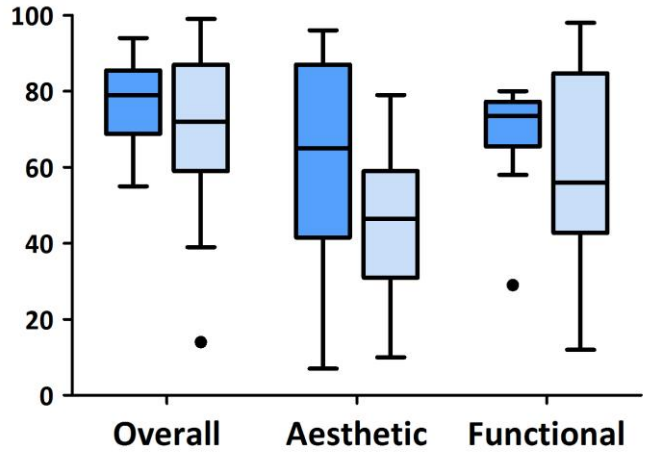
[a] Δ, change scores: postoperative score minus preoperative score, [b] Mann-Whitney U, [c] based on Mann Whitney U test.

Abbreviations: IQR: interquartile ranges, mm: millimetre, n: number.

Table 4. Facial Clinimetric Evaluation (FaCE) scale (sub) scores

	Gracilis transplantation (n=10)	Temporalis transposition (n=12)	Test-statistic[a]	*p*-value[b]
FaCE total score	62.5 (49.2; 68.8)	60.8 (57.1; 65.0)	53.0	0.660
FaCE sub scores				
Facial movement score	25.0 (16.7; 52.3)	25.0 (8.3; 47.9)	48.0	0.439
Facial comfort score	75.0 (47.9; 85.4)	66.7 (52.1; 87.5)	50.0	0.525
Oral function score	75.0 (46.9; 81.3)	81.3 (62.5; 87.5)	46.0	0.363
Eye comfort score	31.3 (12.5; 65.6)	50.0 (50.0; 71.9)	38.5	0.160
Lacrimation control score	50.0 (25.0; 56.3)	37.5 (6.3; 50.0)	50.0	0.501
Social function score	87.5 (73.4; 95.3)	71.9 (53.1; 87.5)	34.0	0.087

[a] Mann-Whitney U, [b] based on Mann-Whitney U test.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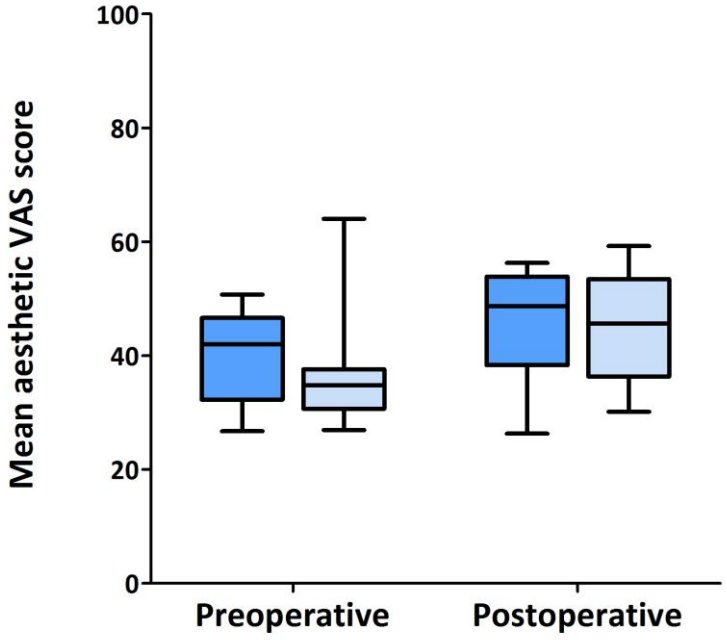
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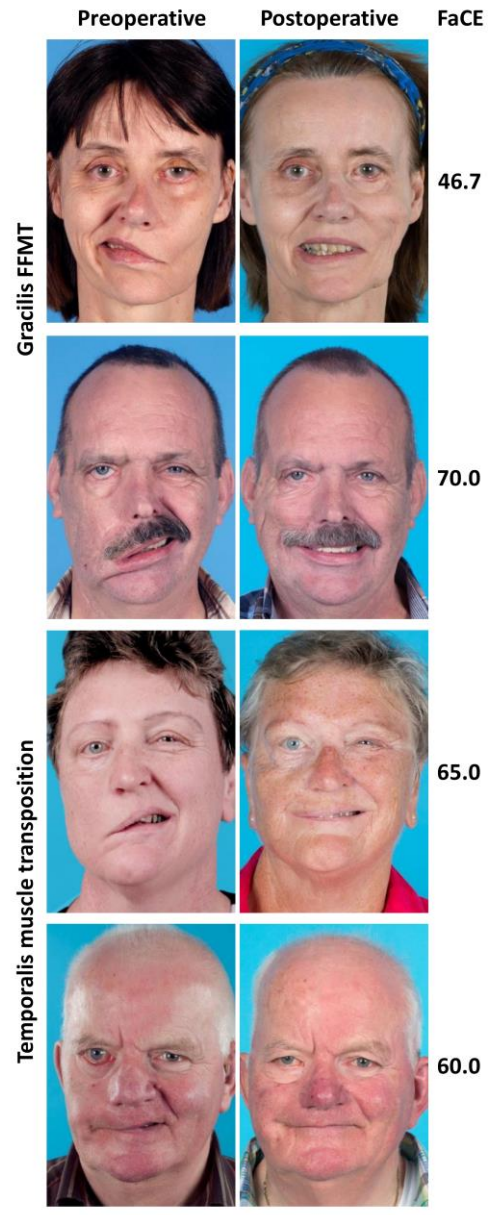
Preoperative
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Gracilis FFMT
46.7
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Temporalis muscle transposition
65.0
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